

# Aimy Wissa. Ph.D.

Assistant Professor, Mechanical and Aerospace Engineering  
Director of the Bioinspired Adaptive Morphology (BAM) lab



## ✈ CONTACT INFORMATION

Email: [awissa@princeton.edu](mailto:awissa@princeton.edu)

Research Website: <http://bamlab.princeton.edu>

Full list of Publications and Citations: <https://scholar.google.com/citations?hl=en&user=1SHzkWUAAAAJ>

## ✈ RESEARCH EXPERTISE

- Avian-inspired deployable structures, wing morphing, and flow control
- Insect-scale energetics and locomotion
- Multi-modal and multi-media bioinspired locomotion
- Bioinspired design of adaptive structures for aerial and ground robotic applications
- Design and experimental evaluation of avian-scale flapping-wing systems
- Aeroelastic tailoring of adaptive structures (e.g., morphing wing, compliant deployable structures)

## ✈ EDUCATION

### Master of Science and Doctorate Degrees

University of Maryland, Aerospace Engineering

**Graduated: August 2014**

Dissertation Topic: Design and Testing of Passive Wing Morphing for Ornithopters.

### Bachelor of Science

The Pennsylvania State University, Aerospace Engineering

**Graduated: December 2008**

## ✈ PROFESSIONAL APPOINTMENTS

- Assistant Professor, Mechanical and Aerospace Engineering, Princeton University (2022-Present)
- Assistant Professor, Mechanical Science & Engineering, Univ. of Illinois at Urbana-Champaign (2015-2022)
- Post-doctoral Scholar, Mechanical Engineering, Stanford University (2014-2015)

## ✈ DESIGN-FOCUSED TEACHING

1. **Structural Dynamics:** Advanced principles of dynamics necessary for structural analysis; solutions of eigenvalue problems for discrete and continuous elastic systems, solutions to forced response boundary value problems by direct, modal, and transform methods (Maryland: 2012-2013)
2. **Mechanical System Design:** Design of custom mechanical components, selection of common machine elements, and selection of electric motors and transmission elements (Stanford:2014)
3. **Mechanical Design I:** Kinematics and dynamics of machinery, including analytical kinematics, force analysis, cam design, and balancing (UIUC:2015-Present)
4. **Global Engineering Design Thinking, Innovation, and Entrepreneurship:** A course sequence (a, b, and c) that immerses students in a real-world, globally distributed engineering design experience in the spirit of a Silicon Valley start-up, teaching them to manage the chaos and ambiguity inherent in professional design (Stanford:2014-2015)
5. **Bioinspired Design:** A unique interdisciplinary advanced design experience in the field of bioinspiration. Throughout the semester, students will work in interdisciplinary teams and learn how to integrate biology into the engineering design process. (UIUC and Princeton: 2016-Present)

## ✈ HONORS AND AWARDS

1. NSF CAREER Award 2021
2. SPIE Smart Structures + Nondestructive Evaluation (NDE) Best Student Paper award (2019)
3. SPIE Smart Structures + NDE Bioinspiration, Biomimetics, and Bioreplication Best Paper (2019)
4. Air Force Office of Scientific Research Young Investigator Award (2018)
5. Air Force Research Lab Summer Faculty Fellowship (2016, 2018)
6. ASME Adaptive Structures and Material Systems Best Structural Dynamics and Control Award (2018)

7. Biom'Innovate Challenge Award at the European Center for Excellence in Biomimicry (2nd Place, 2017)
8. ASME Adaptive Structures and Material Systems Best Structural Dynamics and Control Award (2016)

## ✈ SELECTED PUBLICATIONS

### A. Archival Journal Publications

1. Saro-Cortes, V., Cui, Y., Dufficy, T., Boctor, A., Flammang, B., **Wissa, A.** "An Adaptable Flying Fish Robotic Model for Aero- and Hydrodynamic Experimentation," *Integrative and Comparative Biology* (2022)
2. Bolmin, O., McElrath, T., **Wissa, A.**, & Alleyne, M. "Scaling of Jumping Performance in Click Beetles (Coleoptera: Elateridae)," *Integrative and Comparative Biology* (2022)
3. Barley, W., Ruge-Jones, L., **Wissa, A.**, Suarez A., Alleyne, M., "Addressing Diverse Motivations to Enable Bioinspired Design," *Integrative and Comparative Biology* (2022)
4. Angatkina, O., Alleyne A., and **Wissa A** "Path Following for an Origami-Enabled Soft Crawling Robot (OSCaR)," *ASME. J. Mechanisms Robotics* (accepted)
5. Duan, C. and **Wissa A.**, "Covert-inspired Flaps for Lift Enhancement and Stall Mitigation" *Bioinspiration & Biomimetics* (2021) 16 046020
6. Bolmin, O., Socha J.J., Alleyne M., Dunn A., Fezzaa, K., and **Wissa A.**, "Nonlinear elasticity and damping govern ultrafast dynamics in click beetles," *PNAS* (2021) 118 (5) e2014569118
7. Gustafson, K., Angatkina, O., and **Wissa, A.** "Model-based design of a multi-stable origami-enabled crawling robot," *Smart Materials and Structure* (2020) 29 015013
8. Ito, M., Duan, C., and **Wissa. A.** "The Function of the Alula on Engineered Wings: A Detailed Experimental Investigation of a Bioinspired Leading-Edge Device.," *Bioinspiration & Biomimetics* (2019) 14 056015
9. Bolmin, O., Wei L, Hazel AM, Dunn AC, Alleyne M, and **Wissa A** "Latch and release: how the thoracic hinge morphology and mechanics enable the click of Elaterid beetles (Coleoptera: Elateridae)" *Journal of Experimental Biology* (2019) 222: jeb196683
10. Lynch, M., Mandadzhiev, B., and **Wissa, A.** "Bioinspired Wingtip Devices: A Pathway to Improved Aerodynamic Performance during Low Reynolds Number Flight," *Bioinspiration & Biomimetics* (2018)13 036003.
11. Mandadzhiev, M., Lynch, M., Chamorro L., and **Wissa, A.** (invited) "An experimental study of an airfoil with a bio-inspired leading-edge device at high angles of attack," *Smart Materials and Structure* (2017) 26 094008
12. Pagano, A., Yan, T., Chien, B., **Wissa, A.**, and Tawfick, S. "A crawling robot driven by multi-stable origami" *Smart Materials and Structure* (2017) 26 094007.
13. **Wissa, A.**, J. Calogero, N. Wereley, J. E. Hubbard, Jr., and M. Frecker, "Analytical Model and Stability Analysis of the Leading-Edge Spar of a Passively Morphing Ornithopter Wing," *Bioinspiration & Biomimetics* (2015) 10 065003.
14. **Wissa, A.**, Grauer, J., Guerreiro N., Tummala Y., Altenbuchner, C., Hubbard Jr., J.E., Frecker, M., and Roberts R. "Free Flight Testing and Performance Evaluation of a Passively Morphing Ornithopter," *International Journal of Micro Air Vehicles* 7.1 (2015): 21-40.
15. Tummala, Y., **Wissa, A.**, Frecker, M., and Hubbard Jr., J. E" Design and optimization of a contact aided compliant mechanism for passive bending" *Journal of Mechanics and Robotics* (2014) 6 031013
16. **Wissa, A.**, Tummala, Y., Hubbard Jr., J. E., and Frecker, M. (invited) "Passively Morphing Ornithopter Wings using a Novel Compliant Spine: Design and Testing," *Smart Materials and Structures* (2012) 21 094028

### B. Technical Conference Publications

1. Othman, A., Nirmal, N., Sandeep, A., Goza, A. and **Wissa, A.** "Numerical and Experimental Study of a Covert-Inspired Passively Deployable Flap for Aerodynamic Lift Enhancement," AIAA 2022-3980. AIAA AVIATION 2022 Forum. June 2022.
2. Zekry, D., Duan, C., Ito, M., and **Wissa, A.** "Design of Experiments for Two- and Three-Dimensional Bio-inspired Flow Control Devices," AIAA 2021-0467. AIAA Scitech 2021 Forum. January 2021
3. Lee, K, and **Wissa A.** Dynamic characterization of a bio-inspired variable stiffness multi-winglet device." *Behavior and Mechanics of Multifunctional Materials IX*. Vol. 11377. International Society for Optics and Photonics, 2020.

4. Gustafson, K., Urrutia, L., Pankonien, A., Reich, G., and **Wissa, A.**, “Adaptive and compliant wingtip devices enabled by additive manufacturing and multi-stable structures,” in Proc. SPIE, 2019, vol. 10965.
5. Ito, M., Chamorro, L., and **Wissa, A.** “A Leading-Edge Alula-Inspired Device (LEAD) for Stall Mitigation and Lift Enhancement for Low Reynolds number Finite Wings,” Proc. Smart Materials, Adaptive Structures, and Intelligent Systems Conf. 2018-8170, San Antonio, TX.
6. Duan, C., Waite, J., and **Wissa, A.** “Design Optimization of a Covert Feather-Inspired Deployable Structure for Increased Lift,” Proc. AIAA Aviation Conf. 2018-3174, Atlanta, GA.
7. Angatkina O, Chien B, Pagano A, Tawfick, S., Alleyne, A., **Wissa, A.**, “A Metameric Crawling Robot Enabled by Origami and Smart Materials.” ASME. Smart Materials, Adaptive Structures, and Intelligent Systems, 2017-3836.
8. Bolmin, O., Urrutia, U., Abdulla, A., Hazel, A., Alleyne, M., Dunn, A., and **Wissa, A.** “Pop! Observing and Modeling the Legless Self-righting Jumping Mechanism of Click Beetles.” Biomimetic and Biohybrid Systems. Living Machines 2017. Lecture Notes in Computer Science, Vol 10384. Springer, Cham
9. Mandadzhiev, B., Lynch, M., Chamorro, L., and **Wissa, A.** “Alula-inspired Leading Edge Device for Low Reynolds Number Flight,” Proc. Smart Materials, Adaptive Structures, and Intelligent Systems Conf. 2016-9210, Stowe, VT.
10. **Wissa, A.**, Han, k., and Cutkosky, M. “Wings of a Feather Stick Together: morphing wings with barbule-inspired latching,” Proceedings of 4th International Conference on Biomimetic and Biohybrid Systems, 2015, Barcelona Spain
11. **Wissa, A.**, Tummala Y., Hubbard Jr., J. E., Frecker M, and Northrup M. “Inertial effects due to passive wing morphing in ornithopters” Proceedings of 22nd AIAA/ASME/AHS Adaptive Structures Conference, 2014-1123, National Harbor, MD
12. **Wissa, A.**, Guerreiro N., Grauer, J., Hubbard Jr., J.E., Altenbuchner, C., Tummala Y., Frecker, M., and Roberts R. “Flight testing of novel compliant spines for passive wing morphing on ornithopters,” Proc. 21st Adaptive Structures Conference, 2013-1516, Boston MA
13. **Wissa, A.**, Tummala Y., Hubbard Jr., J. E., Frecker M., and Brown, A. “Testing of novel compliant spines for passive wing morphing,” Proc. Smart Materials, Adaptive Structures, and Intelligent Systems Conf. 2011-5198, Scottsdale, AZ
14. Tummala, Y., **Wissa A.**, Frecker, M., and Hubbard Jr., J. E. “Design of a passively morphing ornithopter wing using a novel compliant spine” Proc. Smart Materials, Adaptive Structures, and Intelligent Systems Conf. 2010-3637, Philadelphia PA

*A full Publications list can be found at <https://scholar.google.com/citations?hl=en&user=dVxk0MAAAAJ>*

### SELECTED INVITED TALKS

1. “Pop! The kinematics, dynamics, and power flow of ultrafast movements in click beetles,” Fast Movements: Nature, Robotics and Materials Symposium Invited Talk (2022)
2. “A Click Beetle Inspired Robotic Model Organism: The design and power transfer modeling approach,” Energy Storage and Delivery in Robotics Systems Workshop, ICRA Invited Talk (2022)
3. “Bio-inspired Locomotion Strategies: From feather-inspired flow control to beetle-inspired power amplification” Departmental Seminar, Brown University (2021)
4. “Bio-inspired Locomotion Strategies: From feather-inspired flow control to beetle-inspired power amplification” Departmental Seminar, Brown University (2021)
5. “Bio-inspired Multifunctional Structures: Distributed Elasticity for Flow Control and Extreme Dynamics” Departmental Seminar, MIT (2020)
6. “Bioinspired Aerial and Terrestrial Locomotion Strategies” ASME SMASIS Bioinspired Materials and Structures Symposium Invited Talk, Louisville KY (2019)
7. “Fly like a Bird” Saturday Engineering for Everyone Seminar Series, Urbana IL (2019)
8. “Adaptive Wings: A pathway towards birds’ superior flight performance” Aerospace Department Seminars, Embry Riddle University, University of Michigan, Auburn University (2017-2019)

9. “Bioinspired Adaptive Systems for Aerial and Terrestrial Locomotion” Aerospace Department Seminar, Pennsylvania State University (2017)
10. “One-way & Two-way Bioinspired Robotics” Robotics-Inspired Biology Workshop, International Conference on Intelligent Robots and Systems, Vancouver CA (2017)

### **SELECTED RESEARCH AND EDUCATION SERVICE ACTIVITIES**

1. Developed a bio-inspired design course for undergraduate and graduate students. (2015-present)
2. Graduated 7 M.S. students and Mentored 3 Ph.D. students through their preliminary exam (2015-present)
3. ASME’s Bioinspired Material and Systems technical committee chair (2016-Present)
4. Guest editor for the Smart Materials and Structures (SMS) Journal (2017)
5. Scientific Referee for Smart Material and Structures, Journal of Intelligent Systems and Structures, SoRo, Journal of Experimental Biology, and Biomimetics and Bioinspiration (2014-Present)
6. Mentored more than 20 undergraduate research students at the Bio-inspired Adaptive Morphology Lab. (2015-Present)

### **SELECTED DIVERSITY, INCLUSION, AND OUTREACH ACTIVITIES**

1. Mentored several undergraduate researchers who are underrepresented minorities (URM) in STEM through numerous summer research projects (e.g., REU programs), and independent study programs (2015-Present)
2. Served as a mentor for the ARISE program, a 5-year program that provides academically talented students coming from low-income backgrounds to successfully earn their engineering degrees from the University of Illinois (2017-2019)
3. Planned, organized, and executed several events for high, middle, and elementary school girls and students (2015-Present)
  - a. Participated in the Paper 2 Tree program for three years in a row to introduce URM 5<sup>th</sup> graders to flight and bioinspired design
  - b. Led robotics-focused outreach events for a local elementary school
  - c. Organized an event for the Girls Build Awesome Machines (G-BAM) summer camp at UIUC
  - d. Organized an event for the Explore Illinois STEM summer camp at UIUC
4. Planned and secured funding for an outreach program in collaboration with the office of minority student affairs (OMSA) to host a 6-week program to introduce engineering to the Upward Bound Prep Academy program participants. The program serves approximately 102 local underrepresented middle and high school students (2020-Present)
5. Recruited and currently lead a diverse research group consisting of 43% women and 72% URM graduate research assistants.

### **NEWS AND MEDIA COVERAGE**

Visit <https://www.bamlab.princeton.edu/news-events> for a summary of our most recent lab news.